

1 CLAIMS:

2 1. A method of forming a trench isolation region comprising:
3 forming a trench within a substrate;
4 forming a first layer comprising a silanol to partially fill the
5 trench;
6 converting at least some of the silanol to a compound comprising
7 at least one of SiO_n and RSiO_n , where R comprises an organic group;
8 and
9 forming a second layer comprising an electrically insulative material
10 over the converted silanol to within the trench.

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12 2. The method of claim 1 wherein the trench has sidewalls, and
13 further comprising thermally oxidizing at least some of the trench
14 sidewalls intermediate the converting and the forming of the second
15 layer.

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17 3. The method of claim 1 wherein the trench has a trench
18 depth, the first layer filling at least 25% of the trench depth.

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20 4. The method of claim 1 wherein the trench has a trench
21 depth, the first layer filling 35% or less of the trench depth.

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5. The method of claim 1 wherein the second layer fills the
trench.

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6. The method of claim 1 wherein the silanol comprises methyl silanol and R is a methyl group.

7. The method of claim 1 wherein the second layer is formed by chemical vapor deposition.

8. The method of claim 1 wherein the second layer is formed by plasma-enhanced chemical vapor deposition.

9. The method of claim 1 wherein the second layer comprises SiO_2 .

10. The method of claim 9 wherein the SiO_2 is formed by a high density plasma.

11. The method of claim 1 wherein the trench comprises sidewalls, thermally oxidizing the sidewalls prior to forming the first layer.

1 12. The method of claim 1 wherein the trench comprises
2 sidewalls, thermally oxidizing the sidewalls after forming the first layer
3 and before forming the second layer.

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5 13. The method of claim 1 wherein the trench comprises
6 sidewalls and the first layer adds 200 angstroms or less of layer to the
7 sidewalls.

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9 14. The method of claim 1 wherein prior to forming the second
10 layer, maintaining the first layer at a temperature of at least about 300°
11 C and at a pressure of at least about 10 atmospheres effective to drive
12 water from first layer.

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14 15. The method of claim 1 wherein converting the first layer
15 comprises exposing the first layer to ultraviolet light.

16. A method of forming a trench isolation region comprising:
1 forming a trench within a substrate;
2 chemical vapor depositing an electrically insulating first layer to
3 within the trench to partially fill the trench;
4 forming a second layer comprising a silanol over the first layer to
5 within the trench; and
6 converting at least some of the silanol to a compound comprising
7 at least one of SiO_n and RSiO_n , where "R" comprises an organic group.

17. The method of claim 16 wherein the trench is formed in
1 silicon, and wherein the chemical vapor depositing comprises substantially
2 selectively depositing an oxide over exposed silicon within the trench.

18. The method of claim 17 wherein the substantially selectively
1 depositing the oxide comprises flowing O_3 and TEOS to within the
2 trench.

1 19. The method of claim 16 wherein the trench comprises
2 silicon-comprising sidewalls and a silicon-comprising base, and further
3 comprising forming an electrically insulative layer over the sidewalls and
4 the base; anisotropically etching the insulative layer to expose silicon of
5 the base while leaving silicon of the sidewalls covered; and the chemical
6 vapor depositing comprising substantially selectively depositing an oxide
7 over the exposed trench base.

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9 20. The method of claim 19 wherein the forming of the
10 electrically insulative layer comprises chemical vapor deposition.

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12 21. The method of claim 19 wherein the electrically insulative
13 material comprises silicon dioxide, and the forming of the electrically
14 insulative layer comprises thermal oxidation.

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16 22. The method of claim 16 wherein the trench has sidewalls,
17 and further comprising thermally oxidizing at least some of the trench
18 sidewalls intermediate the chemical vapor depositing and the forming of
19 the second layer.

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21 23. The method of claim 16 wherein the trench has a trench
22 depth, the first layer filling at least 25% of the trench depth.

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24. The method of claim 16 wherein the second layer fills the
trench.
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25. The method of claim 16 wherein the silanol comprises methyl silanol and R is a methyl group.
26. The method of claim 16 wherein the first layer is deposited by plasma-enhanced chemical vapor deposition.
27. The method of claim 16 wherein the first layer comprises SiO₂.
28. The method of claim 27 wherein the SiO₂ is deposited by a high density plasma.
29. The method of claim 16 further comprising thermally oxidizing sidewalls of the trench prior to depositing the first layer.
30. The method of claim 16 further comprising thermally oxidizing sidewalls of the trench after depositing the first layer and before forming the second layer.

31. The method of claim 16 further including maintaining the second layer at a temperature of at least about 300° C and at a pressure of at least about 10 atmospheres effective to drive water from the second layer.

32. The method of claim 16 wherein converting the second layer comprises exposing the second layer to ultraviolet light.

33. A method of forming a trench isolation region comprising: forming a trench within a substrate, the trench comprising silicon-comprising sidewalls and a silicon-comprising base; forming a first electrically insulative layer over the sidewalls and base; anisotropically etching the first electrically insulative layer to expose silicon of the base while leaving silicon of the sidewalls covered; substantially selectively chemical vapor depositing a second electrically insulative layer over the exposed trench base; and forming a third electrically insulative layer over the first and second insulative layers to within the trench.

1 34. The method of claim 33 wherein the third electrically
2 insulative layer comprises a silanol, and further comprising converting at
3 least some of the silanol to a compound comprising at least one of SiO_n
4 and RSiO_n , where R comprises an organic group.

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6 35. The method of claim 34 wherein the silanol comprises methyl
7 silanol and R is a methyl group.

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9 36. The method of claim 33 wherein the substantially selectively
10 depositing comprises flowing O_3 and TEOS to within the trench to form
11 an oxide.

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13 37. The method of claim 33 wherein the third electrically
14 insulative layer comprises SiO_2 .

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16 38. The method of claim 33 wherein the third electrically
17 insulative layer is formed by plasma-enhanced chemical vapor deposition.

1 39. A method of forming a trench isolation region comprising:
2 forming a trench within a substrate, and the trench comprising
3 sidewalls and a base;

4 thermally oxidizing the sidewalls and base of the trench in an
5 oxidizing environment, the oxidizing environment comprising oxygen and
6 hydrogen and having a greater molar concentration of hydrogen than
7 oxygen;

8 forming a layer comprising a silanol to within the trench; and
9 converting at least some of the silanol to a compound comprising
10 at least one of SiO_n and RSiO_n , where R comprises an organic group.

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12 40. The method of claim 39 wherein the silanol comprises methyl
13 silanol and R is a methyl group.

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15 41. The method of claim 39 wherein the oxidizing environment
16 further comprises maintaining the substrate at from 800°C. to 1100°C.

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18 42. The method of claim 39 wherein the oxidizing environment
19 further comprises maintaining the substrate within a reactor having a
20 pressure at from 10 Torr to 760 Torr.

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2 43. The method of claim 39 wherein the oxidizing environment
3 further comprises maintaining the substrate within a reactor at from
4 800°C to 1100°C and a pressure at from 10 Torr to 760 Torr.
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8 44. A method of forming a trench isolation region comprising:
9 forming a trench within a substrate, and the trench comprising
10 sidewalls and a base;
11 and

12 after the converting, thermally oxidizing the sidewalls and base of
13 the trench in an oxidizing environment.

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15 45. The method of claim 44 wherein the silanol comprises at
16 least one of $\text{Si}(\text{OH})_x$ and $(\text{CH}_3)_y\text{Si}(\text{OH})_{4-y}$, and the converting comprises
17 converting at least some of the $\text{Si}(\text{OH})_x$ if present to SiO_2 and at least
18 some of $(\text{CH}_3)_y\text{Si}(\text{OH})_{4-y}$ if present to $(\text{CH}_3)_x\text{SiO}_{2-x}$.

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20 46. The method of claim 44 wherein the oxidizing environment
21 further comprises maintaining the substrate in a reactor at from 850°C
22 to 1150°C and a pressure at from 10 Torr to 760 Torr.
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1 47. A method of forming a trench isolation region comprising the
2 following steps:

3 forming a trench within a substrate;
4 forming a first layer comprising at least one of Si(OH)_x and
5 $(\text{CH}_3)_y\text{Si(OH)}_{4-y}$ to partially fill the trench;
6 converting at least some of the Si(OH)_x if present to SiO_2 and at
7 least some of $(\text{CH}_3)_y\text{Si(OH)}_{4-y}$ if present to $(\text{CH}_3)_x\text{SiO}_{2-x}$; and
8 after the converting, forming a second layer comprising an
9 electrically insulative material to within the trench.

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11 48. The method of claim 47 wherein the trench has sidewalls,
12 and further comprising thermally oxidizing at least some of the trench
13 sidewalls intermediate the converting and the forming of the second
14 layer.

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16 49. The method of claim 47 wherein the trench has a trench
17 depth, the first layer filling at least 25% of the trench depth.

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19 50. The method of claim 47 wherein the second layer comprises
20 SiO_2 .

1 51. The method of claim 50 wherein the SiO₂ is formed by a
2 high density plasma.

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4 52. The method of claim 47 wherein the trench comprises
5 sidewalls, and further comprising thermally oxidizing the sidewalls prior
6 to forming the first layer.

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8 53. The method of claim 47 wherein the trench comprises
9 sidewalls, and further comprising thermally oxidizing the sidewalls after
10 forming the first layer and before forming the second layer.

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12 54. The method of claim 47 wherein the trench comprises
13 sidewalls and the first layer adds 200 angstroms or less of layer to the
14 sidewalls.

1 55. A method of forming a trench isolation region comprising the
2 following steps:

3 forming a trench within a substrate;
4 forming a high density plasma proximate the substrate to deposit
5 a first layer of material to partially fill the trench;
6 forming a second layer comprising at least one of Si(OH)_x and
7 $(\text{CH}_3)_y\text{Si(OH)}_{4-y}$ over the first layer to within the trench; and
8 converting at least some of the Si(OH)_x if present to SiO_2 and at
9 least some of $(\text{CH}_3)_y\text{Si(OH)}_{4-y}$ if present to $(\text{CH}_3)_x\text{SiO}_{2-x}$.

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11 56. The method of claim 55 wherein the trench has sidewalls,
12 and further comprising thermally oxidizing at least some of the trench
13 sidewalls intermediate the forming of the high density plasma and the
14 forming of the second layer.

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16 57. The method of claim 55 wherein the trench has a trench
17 depth, the first layer filling at least 25% of the trench depth.

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19 58. The method of claim 55 wherein the second layer fills the
20 trench.

1 59. The method of claim 55 wherein the first layer comprises

2 SiO_2 .

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4 60. The method of claim 55 wherein the trench comprises

5 sidewalls, and further comprising thermally oxidizing the sidewalls prior

6 to forming the first layer.

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8 61. The method of claim 55 wherein the trench comprises

9 sidewalls, and further comprising thermally oxidizing the sidewalls after

10 forming the first layer and before forming the second layer.

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12 62. The method of claim 55 further including maintaining the

13 second layer at a temperature of at least about 300° C and at a pressure

14 of at least about 10 atmospheres effective to drive water from second

15 layer.

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17 63. The method of claim 55 wherein converting the second layer

18 comprises exposing the second layer to ultraviolet light.

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